NOTES ON THE COMPOSITION AND STRUCTURE OF THE HENDERSONVILLE, NORTH CAROLINA, METEORITE.

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All the information available concerning the fall, the finding, and general appearance of the stone here described was given by Prof. L. C. Glenn more than two years ago,[a] with the expectation at that time that the paper here given would shortly follow. Through various causes the matter has been delayed until the present.

According to Professor Glenn, the stone undoubtedly fell in or about 1876, but none of it was found until 1901. The mass, as received by him, weighed 11 pounds and 6 ounces (5.17 kilograms), but the original weight was considered as probably some 2 pounds greater, two pieces having been broken off and used in making an assay. The total weight of the original was, then, probably not far from 6 kilograms. The shape of the mass is shown in Plate VIII, fig. 1, being the stone as received by Professor Glenn, and fig. 2 that of the portion secured for the U. S. National Museum (Cat. No. 85264). Resting on its base, the stone is very nearly cubical, the dimensions being 15.5 cm. by 15 cm. by 14 cm. It is firm and hard, without cracks, notwithstanding its long exposure, though considerably rusted throughout the interior.

In structure the stone is kugel chondritic and under the microscope presents, so far as observed, no very unusual features. Two pyroxenes, enstatite and a monoclinic form, and olivine make up the silicate portion, with the usual sulphides and metallic portion. The general microstructure of the stone is shown in figs. 1 and 2 of Plate IX. The "kugels" of radiating and cryptocrystalline enstatites are of a gray color and sharply differentiated from the groundmass, though usually breaking with it (fig. 1., p. 80). Chondrules of the ordinary porphyritic

[a] American Journal of Science, XVII, 1904, p. 215.

enstatite and olivine type are common, also of the grate and barred type of the latter mineral (fig. 2, Plate IX). The groundmass consists of an aggregate of olivines, enstatites, and augites, with the customary sprinkling of metallic iron. No true glass was observed. As usual, the monoclinic pyroxene is of much the same general appearance as the enstatite, but readily distinguished therefrom by its inclined though low angle (18°–25°) of extinction. The structure as a whole is much confused, a feature common to stones of this class.

The most interesting feature is the presence of occasional small areas like that shown near the center in fig. 1, Plate IX. This, under a low power, has all the appearance of a fragment of clastic rock composed of rounded and irregular particles, all of the same mineralogical nature (in this case olivine), embedded in a cement seemingly irresolvable but showing polarizing points. Under as high a power as the thickness of the section warrants using, this interstitial material is seen to polarize faintly and to have a granular to fibrous structure. In some instances indistinct finger-like prolongations extend out from the borders of the granules into the interstices. The structure is not at all that of minerals crystallizing freely from a molten magma, but is suggestive of a partial recrystallization of fine detrital material, as seen in sundry metamorphic schists. The same feature is shown in the fine interstitial portions of fig. 2 of the same plate. It is practically impossible to cut sections thin enough to enable one to write as definitely as desirable, but the structure in both these cases is strongly suggestive of that seen in the meteorite of Kernouvé, France, and which F. Rinne,[a] following Tschermak, regards as due to a mechanical trituration and resintering from a subsequent elevation of temperature.

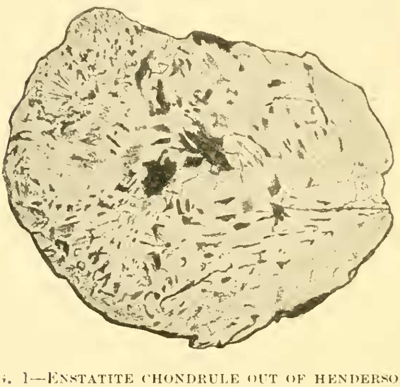

Fig. 1—Enstatite chondrule out of Hendersonville meteorite.

The chemical composition of the stone, as worked out by Mr. Tassin, is as follows:

The portion taken for analysis was badly oxidized. It was therefore kept for some time at a temperature below red heat in an atmosphere of hydrogen.

The nickel iron was determined in a portion of the mass weighing 2.100 grams. This was pulverized and treated with a solution of mercuric

[a] Neues Jahrb. fur Min., etc., II, 1895, p. 229.

ammonium chloride (12 grams of the double salt, $HgCl_2.2NH_4Cl.2H_2O$, to the liter) in an atmosphere of hydrogen. The native metals thus separated were in the following proportions:

Constituents.	Found.	Calculated to 100.
	Per cent.	*Per cent.*
Fe	2.37	91.51
Ni	.21	8.11
Co	.01	.38

The sulphur was determined in a 1.01-gram sample after fusion with sodium carbonate and potassium nitrite. The amount found was 1.61 per cent, which corresponds to 4.43 per cent of troilite. The phosphorus was determined in a 1.5235-gram sample, and 0.012 per cent was found, which corresponds to 0.08 per cent of schreibersite.

The separation of the silicates was effected in a 2.63-gram fragment by treating the finely pulverized mass with dilute hydrochloric acid, specific gravity 1.06, on the water bath for two hours, repeating this operation twice, followed by boiling the moist residue of undecomposed silicate with a solution of sodium carbonate, since the major part of the silica of the soluble silicate will be here found.

The analysis of the soluble silicate gave:

Constituents.	Found.	Calculated to 100.
	Per cent.	*Per cent.*
SiO_2	15.66	38.34
FeO	9.44	23.10
Al_2O_3	0.20	0.49
Cr_2O_3	0.03	0.07
CaO	0.15	0.36
MgO	15.38	37.46

The insoluble silicates, analysis below, were decomposed by fusion with sodium carbonate. The alkalies were determined in a separate portion.

Constituents.	Found.	Calculated to 100.
	Per cent.	*Per cent.*
SiO_2	30.40	56.01
FeO	4.89	9.01
Al_2O_3	2.00	3.68
Cr_2O_3	0.20	0.37
CaO	1.98	3.65
MgO	13.24	24.39
K_2O	0.10	0.18
Na_2O	0.96	1.77
Chromite	0.51	0.94
	54.28	100.00

The general composition of the meteorite may be arrived at by combining the results of the several determinations, thus:

	Per cent.
Fe	2.37
Ni	0.21
Co	0.01
S	1.61
P	0.012
SiO_2	46.06
FeO	14.33
Al_2O_3	2.20
Cr_2O_3	0.23
CaO	2.13
MgO	28.62
K_2O	0.10
Na_2O	0.96
Residue (chromite)	0.51
	99.352

From these several analyses it is possible to arrive at the following approximation of the relative quantities of the different constituents:

	Per cent.
Nickel iron	2.59
Troilite	4.43
Schreibersite	.08
Chromite	.80
Olivine	40.48
Pyroxenes	51.62
	100.00

In the above the amount of the nickel-iron is given as directly determined. The sulphide and phosphide of iron are calculated from the amount of sulphur and phosphorus found; the chromite is similarly calculated. The soluble silicate is regarded as olivine; the insoluble silicate as being largely enstatite, with some augite.

EXPLANATION OF PLATES.

Plate VIII.

The Hendersonville, North Carolina, Meteorite.

Fig. 1. The stone as it came into the possession of Professor Glenn.

2. The portion of the stone now in the U. S. National Museum, viewed from side opposite to that shown in fig. 1.

Plate IX.

Microstructure of Hendersonville, North Carolina, Meteorite.

Fig. 1. Black areas, metallic iron and iron sulphide; light, olivines and enstatite. Near the center an indistinctly chondritic mass with structure suggestive of sintering of finely pulverized olivines.

2. Light and dark areas as in fig. 1. At the bottom an olivine chondrule. Large colorless areas in the upper left quadrant are enstatites. The section shows to advantage the finely pulverulent granular structure characteristic of much of the interstitial matter.